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PROBLEM ORIENTED WILLED MOVEMENT THERAPY ON MOTOR ABILITIES OF TRAUMATIC BRAIN INJURY PATIENTS WITH COGNITIVE DEFICITS

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ABSTRACT

Background: Cognitive deficits after traumatic brain injury are common and interfere with recovery. The purpose of this study was to determine whether the motor abilities of subjects who have cognitive deficits post TBI and who have received problem-oriented willed movement (POWM) therapy in addition to conventional physiotherapy will improve more than the motor abilities of subjects in the control group who have received conventional physiotherapy alone.

Methods: The subjects recruited for this study were 20 men with TBI and having cognitive deficits as screened by MMSE. Subjects who met inclusion criteria were conveniently sampled to two groups with 10 in experimental group and 10 in control group. Motor assessment scale was used to assess motor abilities of all subjects. Subjects in experimental group received conventional physiotherapy and Problem Oriented Willed Movement therapy while subjects in control group received conventional physiotherapy alone. Post intervention MAS score was again calculated in both groups after 6 weeks.

Results: Data were analyzed using SPSS software. Domains A, B, C, D & E of MAS improved in both groups ($p < .05$) while domains F, G, H & I did not improved significantly ($p > .05$). Between group analysis showed that improvement was more in experimental group than control group ($p < .05$).

Conclusion: These findings suggest that, POWM intervention in addition to conventional physiotherapy is effective in improving balance and basic mobility in TBI subjects with cognitive deficits and indicates the need to use relatively intact cognitive function or perceptual function, or both, to improve motor rehabilitation for people with cognitive function deficits.

Key Words: Cognitive function, Motor Assessment Scale, Problem Oriented Willed Movement, Traumatic Brain Injury.

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INTRODUCTION:

Traumatic brain injury (TBI) is a non-degenerative, non-congenital insult to the brain from an external mechanical force, possibly leading to permanent or temporary impairment of cognitive, physical, and psychosocial functions, with an associated diminished or altered state of consciousness[1]. Traumatic brain injuries (TBIs) are a leading cause of morbidity, mortality, disability and socioeconomic losses in India and other developing countries[2].TBI can manifest clinically from concussion to coma and death. Injuries are divided into 2 subcategories: (1) primary injury, which occurs at the moment of trauma and manifest as skull fractures, hemorrhage, concussion, contusion, laceration or diffuse axonal injury and (2) secondary injury, which occurs immediately after trauma and produces effects like increased intracranial pressure, swelling or herniation of brain. The incidence of disability in young people and adults admitted with a head injury is quite high with a high rate of sequelae in the large number of patients admitted to hospital with an apparently mild head injury[3]. The outcome for many patients with TBI is an inability to fully participate in life events because of cognitive impairments[4]. Traumatic brain injury (TBI) causes life-long impairments in physical, cognitive, behavioral and social function[5]. Visual perceptual changes, attention deficit and memory dysfunction are evident in patients with severe TBI when compared to a normative sample[6,7,8,9,10]. The cognitive impairment is mainly caused by cholinergic dysfunction following TBI[11].The cognitive, behavioral and personality deficits are usually more disabling than the residual physical deficits. Recovery from TBI can continue for at least 5 years after injury. Rehabilitation is effective using an interdisciplinary approach, and close liaison with the patient, family and care givers. The focus is on issues such as retraining in activities of daily living, pain management, cognitive and behavioral therapies, and pharmacological management. In most physical therapy procedures, the emphasis is almost always on the motor system, and perceptual and cognitive aspects are ignored or treated separately. Therefore, there is currently an urgent need for integrated therapeutic procedures aimed at the restoration of motor abilities for people with cognitive impairments. In Mulder's human motor behavior model, cognitive, perceptual, and motor mechanisms are viewed not as independent elements but as inseparable parts of this functional system[12].The aim of the problem-oriented willed-movement (POWM) approach is to guide people in accomplishing tasks on the basis of their identified cognitive and movement problems. POWM therapy has proved to be effective in improving motor abilities of post stroke patients with cognitive deficits[13]. It indicates the need to use relatively intact cognitive function or perceptual function, or both, to improve motor rehabilitation for people with cognitive function deficits. Since we see that people with traumatic brain injury has cognitive deficits along with residual motor disabilities and as cognitive & motor mechanisms are inseparable parts, hence there is a need for integrated therapeutic procedures aimed at the restoration of motor abilities for people with cognitive impairments post TBI. Also POWM therapy has proved to be effective in improving motor abilities of post stroke patients with cognitive deficits and its effectiveness has not been studied in people with TBI. Also, in the previous study age and duration of stroke was not considered which was a limitation for the study. Furthermore, there has been study which has proved that integrating cognitive strategies into physical therapy has given positive results[14]. It was hypothesized that there will be a significant effect of problem oriented willed movement therapy on motor abilities of traumatic brain injury patients with cognitive deficits.

MATERIALS & METHODS:

All procedures were approved by institutional ethical committee, Padmashree Institute of Physiotherapy, Bangalore, as per the ethical guidelines for biomedical research on human subjects, 2000. ICMR, New Delhi. 20 subjects with TBI with duration between 6-18 months, age between 20-40 years and having mild to moderate cognitive deficits as screened by MMSE were included in the study. Subjects with severe apraxia, global aphasia, recent fractures or blind & deaf subjects were excluded. Included subjects were conveniently sampled to control & experimental group. Experimental group received Problem Oriented Willed Movement Therapy and conventional physiotherapy whereas control group received conventional physiotherapy alone. Motor abilities of subjects in both group were assessed using Motor Assessment Scale (MAS).

Experimental protocol conducted: (Problem Oriented Willed Movement Therapy)[13]: POWM program emphasized the use of intact or relatively preserved sensory and cognitive functions of the participants to facilitate their attention to achieve a specific motor task. The therapy program was composed of a number of stages. First, cognitive, perceptual, and movement functions were assessed. Second, cognitive and motor problems were assessed. Third, individualized treatments for

subjects with different cognitive impairments will be selected.

50-Minute Problem-Oriented Willed-Movement Therapy Treatment Session Format[13]: The outline of the movement before physical therapy (not during the session time) was recited. 5min were allowed for preparatory techniques. A priority was established among the activities, including mat activity, sitting, standing, walking, gait training, and up-down stair training, every 7–10 d on the basis of the movement deficit, the complexity of the motor activity and the subjects' interests.

The techniques used to trigger the active movement for following impairment:

Memory: The goal was to improve motor functions by helping subjects to remember each motor activity. Each movement was practiced 20–25 times per session. Continual reinforcement for maximizing the movement was given until it was initially learned and reinforcement was given intermittently to maintain the movement. Therapy was discontinued or rest given if subjects felt bored or fatigued.

Attention: The goal was to improve motor functions by helping subjects to concentrate on each motor activity. Colorful and interesting objects were used as targets to direct the movement. Motor activities were selected based on the major motor problems and interests of the subjects. Sufficient time for each activity was given. Tactile, auditory, and visual stimuli were used to augment the attention of the subjects.

Language Comprehension: Although no subjects were found with this impairment but the goal was to improve motor function by helping subjects to understand the motor performance instructions of the therapist. Emphasizing by demonstration rather than by verbal instruction. Selecting colorful objects as targets to direct the movement. Selecting a position in which the motor movement is within the vision of the subjects.

Apraxia: Although no subjects were found with this impairment but the goal was to improve voluntary motor function by facilitating involuntary movements used in daily living activities and helping subjects to better understand motor performance. Providing visual and auditory guidance. Demonstrating repeatedly. Practicing the motor activities in front of a mirror. Selecting activities that are usually part of daily living activities to facilitate the involuntary action and reinforcing the involuntary action to facilitate the voluntary action.

Common intervention irrespective of the impairment was willed movement: A target was established for each movement. Subjects were helped to understand the instructions of the therapist by using intact or relatively preserved perceptual or cognitive functions. Sufficient time was given for the subjects to understand and accomplish the movement instruction. Training activities were selected that are within the capabilities of the subjects. Training activities were selected that related to subjects' interests and needs in order to maximize active participation. Active movement was emphasized after passive range of motion. Positive feedback was given for each desired response

Intervention conducted in control group: (Conventional physiotherapy): 5 minutes was allowed for preparatory techniques. A priority was established among the activities, including mat activity, sitting, standing, walking, gait training, and up-down stair training, every 7 d on the basis of the developmental sequence. Therapeutic activities were chosen to match subjects' level of development and to stimulate the next higher level of development. 30–35 min was allowed for therapeutic activities matching subjects' level of development and 10–15 min for activities of the next higher level of development. Each movement was practiced 10–15 times per session.

All the data were collected and statistically analyzed using appropriate statistics.

OUTCOME MEASURE:

- Motor Assessment scale(MAS) [15,16]

RESULTS:

Table 1: Base line data for demographic variable

Variable	Experimental	Control
Age	29.30±2.16	29.6±4.22
Duration	399.0±37.94	400.70±37.06
Loc	6.90±1.60	5.70±1.33
MMSE	17.60±1.26	17.80±1.32
Attention(Affected/NotAffected)	8/2	7/3
Memory(Affected/NotAffected)	8/2	8/2

Table 2: Base line data for outcome variable

Sl. No	Domain	Experimental	Control	p-value
1	A	2.80±.78	2.70±.48	>.912
2	B	3.0±.81	2.90±.73	>.796
3	C	2.60±.69	2.50±.70	>.739
4	D	2.50±.52	2.60±.70	>.853
5	E	2.50±.52	2.60±.52	>.739
6	F	2.30±.67	2.20±.63	>.739
7	G	1.90±.73	1.90±.57	>.971
8	H	2.27±.91	2.33±.47	>.912
9	I	3.0±.01	2.90±.57	>.739

The baseline data for outcome variable in both groups were homogenous as with each domain the differences in scores between both groups were non-significant (p>0.05).

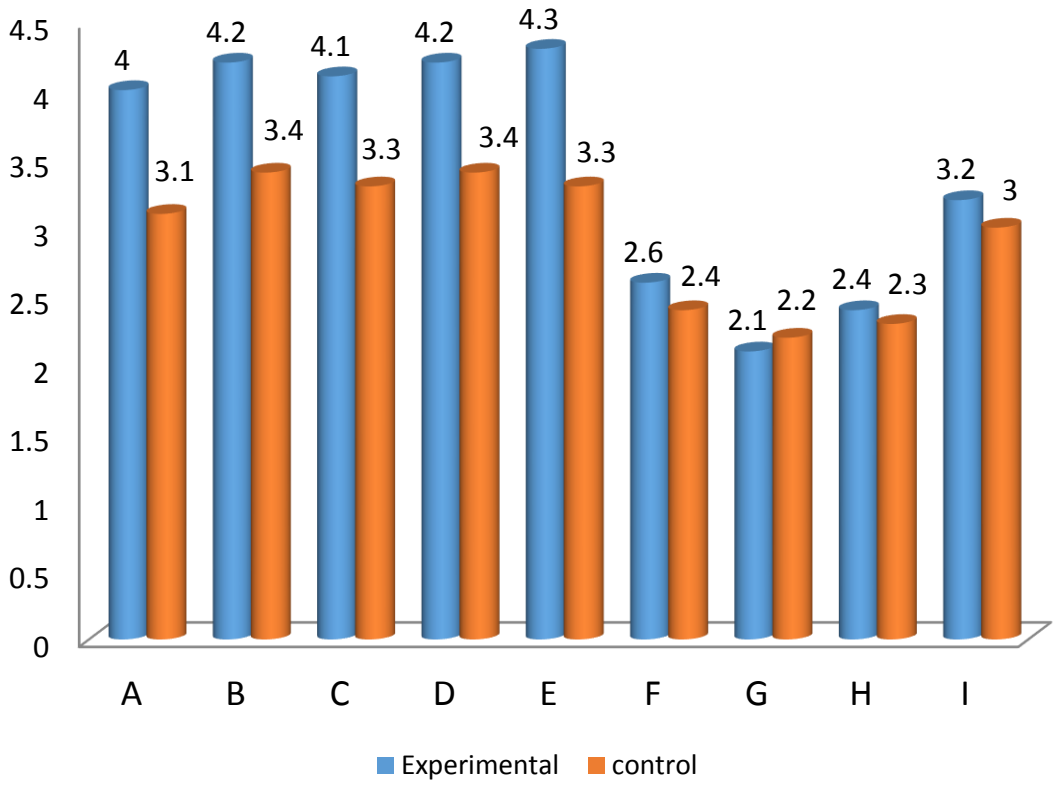
Table3: Within group pre & post values in experimental group

Sl. No	Domain	Pre	Post	p-value
1	A	2.80±.78	4.0±.47	<.010
2	B	3.0±.81	4.20±.42	<.010
3	C	2.60±.69	4.10±.73	<.004
4	D	2,50±.52	4.20±.63	<.004
5	E	2,50±.52	4.30±1.16	<.007
6	F	2.30±.67	2.60 ±.70	>.317
7	G	1.90±.73	2.10±.73	>.317
8	H	2.27±.91	2.40±.52	>.527
9	I	3.0±.01	3.20±.42	>.157

Table 4: Within group pre & post values in control group.

Sl. No	Domain	Pre	Post	p-value
1	A	2.70±.48	3.10±.57	<.046
2	B	2.90±.73	3.40±.70	<.025
3	C	2.50±.70	3.30±.67	<.021
4	D	2.60±.70	3.40±.52	<.033
5	E	2.60±.52	3.30±.82	<.05
6	F	2.20±.63	2.40±.70	>.414
7	G	1.90±.57	2.20±.42	>.180
8	H	2.33±.47	2.34±.48	>.739
9	I	2.90±.57	3.0±.82	>.655

In the experimental group as well as in the control group the domains A, B, C, D & E showed significant improvement(p<0.05) whereas domains F,G,H & I had non-significant improvement(p>0.05).



Graph 1: Within group differences of post values of various domains in both groups.

The domains A, B, C, D, E were more improved in experimental group and were statistically significant whereas other domains were not statistically significant.

DISCUSSION:

The results of analyses of baseline characteristics signifies that both groups were homogenous with respect to age, duration post stroke, severity, cognition & pre scores of MAS. These variables can affect the results of the study by acting as confounding variables. This is particularly important as age, duration & severity has a direct relationship with cognitive & motor deficits. This is in accordance with the study of Senathi-Raja D[17] which showed that with increasing age there is more cognitive deficits. Also it correspondence with the study of Dikmen et al[18] which shows that there is an association with TBI & cognitive deficits 6 months post injury.

It was found that most of the subjects had 2 or more locations of injury in brain; the combination of 2 or more areas of injury might be associated with cognitive deficits. Also the location of injury was in the dominant hemisphere for all the subjects which also correlate with presence of cognitive deficits. These findings are in accordance with studies of subjects with dementia by Erkinjuntti et al.[19]

In the experimental group it was found that the domains A, B, C, D & E of motor assessment scale improved and the improvement was statistically significant. These findings indicate that the motor abilities of subjects with respect to bed mobility, balance & ambulation in the experimental group improved significantly. These data confirmed that many factors contribute to the recovery of motor performance; cognitive function is a very important factor. To perform a skilled motor act, a person must understand what the act entails as shown by Schut LJ[20] , remember long enough to accomplish the act, formulate an organized plan to accomplish the task, create a mental image of the action, and actually execute the detailed plan. These are in accordance with the studies done by Fong K N et al which shows a strong relationship between cognition and motor abilities.[21] Also it correlates with the study of Debaere F et al and Peigneux P et al which signifies importance of remembering and knowing about the task.[22,23] The improvement could also be correlated to study of Alladi S & associates which signified that cognitive abilities, such as judgment, comprehension, and repetition, have a positive relationship with functional performance. [24]

Also in the experimental group it was found that improvements in domains F, G & H which correspond to upper limb function were not statistically significant. This could be due to slower improvement

in upper limb compared to lower limb. This is in accordance with study done by Desrosiers J & associates[25]. The improvement in domain I corresponding to general tonus was also not statistically significant. This can be due to the fact that the treatment protocol did not emphasized on tone aspect and all the subjects were having fluctuating tone which was difficult to assess both before and after treatment.

In the control group it was found that the subjects receiving conventional physiotherapy also improved in domain A, B, C, D & E of MAS and the improvement was statistically significant. The improvement in ambulation could be correlated with the fact that most subjects with mild to moderate TBI achieve independent ambulation within 3 months post injury following conventional rehabilitation as shown in a retrospective study by Katz DI & associates.[26] The gait improvement can also be correlated to the study of Brown, Tracy H &associates which showed that conventional over ground gait training is more effective than the BWSTT for improving gait symmetry during over ground walking in patients with chronic TBI.[27] Also the improvement in other domains of MAS is in accordance with a systematic review by Karen SG Chua of TBI rehabilitation which shows that early induction in trans-disciplinary brain injury rehabilitation program leads to improved outcome and functional benefits.[28]

The non-significant improvement in arm & hand function is in correspondence with the study done by Katz DI & associates which showed that patients with diffuse axonal injury had protracted recovery and the patients with low initial level of impairment had slow recovery.[29]

When comparing between experimental & control group it was found that the improvements were more in intervention group than the control group. As both groups received conventional treatment so the difference in improvement could be attributed to the additive effect of Problem Oriented Willed Movement Therapy. This is similar to the study done by Q P Tang et al in which it was seen that Problem Oriented Willed Movement therapy was more effective than NDT in improving the motor abilities of stroke subjects with cognitive deficits. Because active participation in therapy for people with cognitive impairments is decreasing or lacking, the key points of physical therapy for these individuals are as follows: how to motivate them to consciously pay attention to the movement and how to facilitate understanding of motor learning instruction and active execution of a new motor task. Willed-movement therapy presents a way to achieve conscious attention to movement. In the POWM group, intact or relatively preserved cognitive and sensory functions were stimulated in order to trigger a movement reaction. The improvement in experimental group in the present study can be attributed to the fact that motor and cognition are not separate entity but an integral part of functional system as shown by Theo Mulder in his model of human motor behavior. It can also be hypothesized that as in POWM intervention, subjects attention is directed towards the task so that could result in the improvement as attention is an important aspect of motor learning. As none of the subjects had any language comprehension problem and could easily follow all the instructions so the subject's attention was directed towards external focus.[30] The improvement could also be attributed to the fact that in POWM intervention the approach was task-oriented and repetition of the task was emphasized. Both these elements are key factors to motor learning. Also the subjects were given the opportunity to select the initiation, changing and termination of intervention resulting in more involvement of the subject and thereby subjects were more attentive, enthusiastic and were less tired. One of the major reasons why the intervention group fared better than control can be directly related to the active involvement of the subjects in intervention group. This active involvement results in development of neuronal repertoires which results in better task specific response and selection of appropriate strategies in task performance.

This study has its own limitation as sample size was small and only male subjects were obtained. So it lacks generalization. Also with variable location of injuries and subjective assessment of cognition the results might have been affected. Future studies with subjects with brain tumor, perceptual disorders and executive dysfunction is recommended. Also the study can be replicated using female subjects & larger sample to generalize the results.

CONCLUSION:

The results of present study indicated that significant improvements in balance and basic mobility were obtained in TBI subjects with cognitive deficits when POWM therapy was used with conventional physiotherapy versus when conventional physiotherapy was used alone. However, there was no benefit with respect to upper-extremity function. These results suggested that the POWM intervention is effective in improving balance and basic motilities, including rolling, sitting, standing, and walking, in

subjects who have had TBI and who have cognitive impairments. The findings of this study suggest that therapists should emphasize the role of perceptual and cognitive functions and intentions in managing the mobility of people with cognitive impairments after TBI.

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